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Thermal structure and metamorphic evolution of the Piemont-Liguria metasediments in the Western-Central Alps

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The Western-Central Alps, located between the Simplon and the Aosta-Ranzolla faults, represent a "transition" zone where many paleogeographic domains were continuously accreted within the alpine orogenic wedge. Within this orogenic wedge, the Piemont-Liguria oceanic domain recorded blueschist to eclogite metamorphic conditions during the Alpine orogeny. The Piemont-Liguria zone, is classically divided, according to their metamorphic evolution, into a LP (greenschist to blueschist facies) unit (Combin zone), and a HP to UHP unit (Zermatt-Saas zone). The contact between both zones is supposed to be a major tectonic contact (Combin fault). Although P-T conditions are quite well known in the Zermatt-Saas zone, quantitative constraints are lacking in the Combin zone, because index minerals are scarce or not well preserved.

We investigated the temperature record in the oceanic metasediments of the Piemont-Liguria units, using Raman spectroscopy of carbonaceous material. This method allows quantifying the maximum temperature, and therefore the peak of metamorphism, without being affected by the retrograde evolution. The aim of this study was to (1) estimate the peak temperature reached within each unit (2) compare the temperature record between the different units and precise the thermal structure of the Piemont-Liguria domain. We additionally characterized the metamorphic assemblages in the metasediments of both units. Samples were collected in the metasediments of the Combin zone north and south of the Dent Blanche massif, and in the Zermatt-Saas zone in the area of Zermatt and Lago di Cignana to estimate the temperature gap across the Combin fault.

In the Combin zone, temperatures are in the range 420-510°C, and are very coherent at a regional scale around the Dent Blanche massif. Furthermore an increasing gradient of temperature is observed towards the base of the Combin zone. In the Zermatt-Saas zone, temperatures are similar to the ones obtained in the Combin zone, also in the range 500-540°C, and the temperature gap is significantly lower than proposed in the literature. Similar metamorphic assemblages and textural relationships are also observed in both zones, but the Combin zone was affected by intense greenschist retrogression compared to the Zermatt-Saas zone. Moreover peak temperature was probably reached during retrograde evolution in the Combin zone.

We compare these temperatures with the metamorphic assemblages observed in the different units and discuss the results in the frame of the tectono-metamorphic evolution of the high-pressure low-temperature oceanic units from the Western-Central Alps.